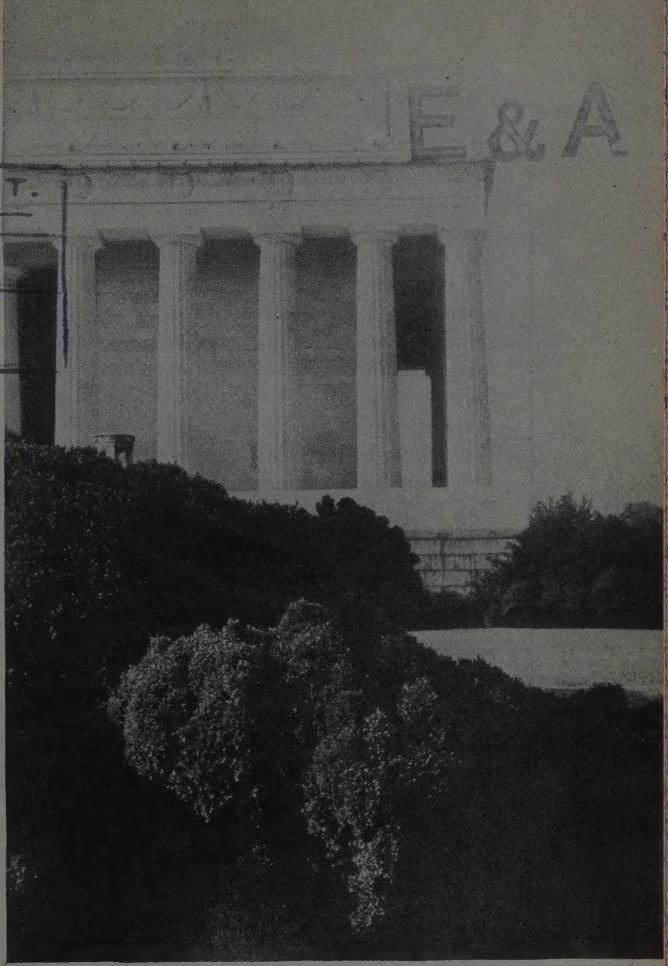
FARMERS'
BULLETIN
No. 1855

MP. INST. ENT.
— LIBRARY —
14 JUN 1941
ERIAL U.S.A.69
EPARATE



ulture, iseases, nd Pests of the Box Tree

1940

UNITED STATES
DEPARTMENT
OF AGRICULTURE

BOXWOODS are horticultural subjects of exceptional charm, especially when they have attained mature size and have accumulated the associations of years of memories and tradition. On many of the estates of the Atlantic seaboard boxwood hedges, boxwood drives, and specimen plants one to two centuries old afford a living connecting link with the historical foundations of the States and even of the Colonies. Such venerable plants merit the best of care.

Within the region of greatest climatic adaptation (Chesapeake Bay to the Blue Ridge) boxwoods that were planted in initially favorable sites will flourish with a minimum of attention. These plants need only periodic feeding and occasional but thorough watering during the drier parts of summer and fall, with emphasis on timeliness and moderation so as to avoid excessive vegetative growth, which is likely to suffer winter injury.

In regions farther north or south greater protection against adverse climatic factors is required, but the general aim should be to attain a rather slow but equal growth through the season, followed by dormancy, without abrupt or extreme changes in temperature or soil moisture.

Given congenial conditions, boxwoods resist disease remarkably well, as most of their ailments originate in some form of environmental injury, usually drought or cold.

The number of insect and related pests that commonly attack boxwood is comparatively small. There are a few pests, however, that may cause serious injury when numerous, and in such cases control measures are usually necessary to preserve the health of the plants.

Washington, D. C. Issued November 1940

cat. fl. sep.

CULTURE, DISEASES, AND PESTS OF THE BOX TREE

E.M.N.

By FREEMAN WEISS, *senior pathologist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry,* and L. G. BAUMHOFER, *associate entomologist, Division of Forest Insect Investigations, Bureau of Entomology and Plant Quarantine*

Contents

	Page
Kinds of box	1
Climatic adaptation	1
Sites and soil	3
Preparation of soil	5
Transplanting	7
Fertilization	7
Watering	9
Winter protection	9
Pruning	10
Diseases	11
Low vitality and general decline	11
Twig blight and leaf cast	11
Wilt and canker	13
Insects and related pests	15
The boxwood leafminer	15
The boxwood psyllid	16
Spider mites	17

KINDS OF BOX

MOST BOX TREES AND SHRUBS in cultivation belong to the species *Buxus sempervirens* L., which is native to southern Europe, North Africa, and the Orient. Two botanical varieties are distinguished, the tree box, often called American box (*B. sempervirens* var. *arborescens* L.) (fig. 1) and the dwarf or English box (*B. sempervirens* var. *suffruticosa* L.) (fig. 2). Several horticultural varieties, especially of the tree box, have been distinguished in the nursery trade. The Japanese box (*B. microphylla* Sieb. and Zucc. var. *japonica* Rehd. and Wils.) and Korean box (*B. microphylla* var. *koreana* Nakai) are also cultivated.

CLIMATIC ADAPTATION

Both the tree and dwarf varieties of *Buxus sempervirens* have been cultivated in the Middle Atlantic States from colonial times, and numerous fine hedges and large individual specimens, reputed to be one to two centuries old, still survive. The center of climatic adaptation appears to be the Chesapeake Bay region and the foothills of the Blue Ridge in Virginia and North Carolina, but fine specimens and plantings are also found in the Piedmont of South Carolina, in Tennessee and Kentucky, in the vicinity of Delaware Bay, and on Long

Island, N. Y. The region indicated by shading in figure 3 is best adapted to boxwood. Because of prolonged hot weather and frequent summer droughts the southern part of this area is not quite so well adapted, and these conditions, combined with lighter soils, make the extreme southeastern part, with local exceptions, even less suitable for boxwood cultivation. The Japanese and Korean boxes are the hardiest varieties, surviving without cover at the Arnold Arboretum, near Boston; the former is also the most popular kind in the

FIGURE 1.—A group of tree boxwoods intergrown so as to appear like a single specimen (dwarf box hedge in foreground).

far South. The area of best adaptation for boxwood is approximately delimited by the following climatic features: (1) Normal minimum temperature in winter not lower than 0° F., (2) a definite period of winter rest with mean temperature between 30° and 40° F., (3) annual rainfall of 30 to 40 inches, about evenly divided between the summer and winter seasons. With artificial winter protection, the cultivation of the dwarf box has extended into southern New England, but where the minimum temperatures reach −10° F., especially if prolonged, boxwood culture becomes highly precarious. The dry, cold

winters of inland regions are also inimical to boxwoods; likewise regions of prevailing or intermittent winter weather that is warm enough to induce growth.

SITES AND SOIL

The box is highly tolerant of shade and is often planted in heavy shade adjacent to walls or under tall trees (fig. 4). It thrives better with more light, however, and does best in full sunlight (fig. 5), provided the soil can furnish enough moisture especially during dry, cold

FIGURE 2.—Dwarf box border and arch framing a garden walk at Mount Vernon, the estate of George Washington. At least the two plants forming the arch over the steps were contemporaneous with the first President.

periods in winter when exposure to strong light may otherwise cause the foliage to sunburn. An ideal site in this respect is one that provides direct sunlight for part of the day and only mottled shade at other times.

Boxwoods will grow in a wide range of soil types from sandy loam to stiff clay, the texture being important only as it influences the moisture-supplying capacity of the soil. The sturdiest growth is made in a fairly stiff clay that is well supplied with organic matter so that it is not given to baking, cracking, or heaving. The soil must be well drained and aerated; boxwoods will not tolerate a soggy or

stagnant soil. The box root system is of a spreading and densely fibrous type. It will penetrate a clay soil and keep pace with the top growth when the plant grows up without disturbance, but if the plant is moved and part of the root system is lost, the root ball should be set in a specially prepared soil to hasten establishment and to avoid transplanting difficulties.

There has been some difference of opinion among gardeners regarding the soil-reaction preference of the box, some holding that an acid

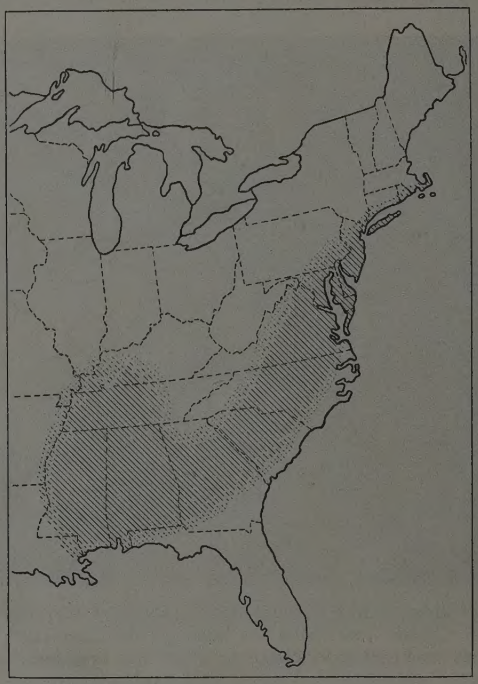


FIGURE 3.—Map showing (by shading) the region most suitable for boxwood cultivation.

soil is most favorable. This belief arises perhaps from the observation that the box responds well to mulching with peat or leafmold or mixing these materials into the soil. Tests show that boxwoods are relatively indifferent to soil reaction; they will grow in a peat soil as acid as that used for rhododendrons, and they thrive in a soil rich in lime. The response to peat or leafmold is probably due to their influence in increasing the porosity and the water-holding power of the soil. Certainly boxwoods do not need an acid soil; in fact, there is some

evidence that the foliage color is a deeper green and the plants are sturdier in a neutral soil or one in which lime is abundant.

In the marginal zone of its range boxwoods need protection against excessive exposure to sunlight and shelter from cold, drying winds, especially in winter. Protection can be furnished by a windbreak of hardier plants or by an artificial covering of burlap or a lattice.

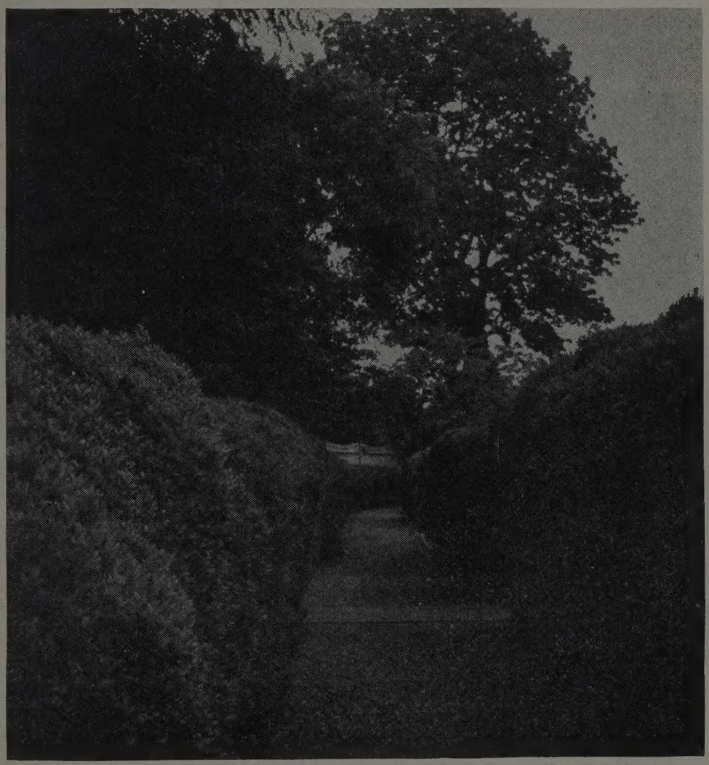


FIGURE 4.—A boxwood walk at Mount Vernon. The adaptability to shade is shown in the density and uniformity of the foliage on both sides of the walk and from the ground to the top of the hedges.

PREPARATION OF SOIL

If a site meets the preceding specifications, nothing more is required by way of preparation for planting except making an opening of ample size for the root system and pulverizing and liberally enriching with stable manure and bonemeal the soil that is to be used for filling. If the soil is stiff and lumpy it should be discarded and woods soil or

topsoil from a meadow used for filling. If good topsoil is not available, the excavated soil should be mixed with peat (sedge or neutral peat is preferable to moss or acid peat, but either may be used) and stable manure, in the proportion 3–1–1. If it is very heavy, sharp quarry sand, fine gravel, or crushed cinders should also be added to lighten it. To a wheelbarrow load of soil (about 2 bushels) a half peck of bonemeal or superphosphate should be added; about the same quantity of agricultural lime or ground oystershell should be added when acid peat or cinders have been used in the mixture.

FIGURE 5.—The box maze at Mount Vernon. These plants are in full sun throughout the day.

In situations characterized by too little slope for prompt run-off of surface water, or where the subsoil is so impervious that excavations made for plants tend to become reservoirs collecting seepage, artificial drainage should be provided. For plants of large size and for hedges the laying of a porous-tile drain is usually justified. A somewhat less efficient but often serviceable drainage system may be a so-called dry ditch, that is, a trench filled with stones or broken bricks. If there is any question at all about the adequacy of subsoil drainage, it is advisable to place a 2- to 6-inch layer of crushed limestone on the bottom of the excavation.

TRANSPLANTING

Boxwoods can be successfully transplanted at any time, except when they are in active growth or when the ground is frozen. The most favorable seasons at Washington, D. C., are from mid-August to the early part of November, and from the first of March to mid-April. For best results it is essential that a solid root ball of ample size be taken, and great care must be exercised in the operation so that the root ball does not crack. For dwarf boxwoods a root ball not less than half the diameter of the top is advisable; a little larger is preferable. For tree boxwoods, a ball about one-third the height of the top is the minimum requirement. It is often difficult to meet these specifications where old box hedges are taken up or specimen plants that have grown close to a wall or a tree are to be moved. Hedge plants not over 4 feet in height can be successfully transplanted even without a solid root ball if the roots are firmly packed, or preferably puddled in specially prepared soil, as described under Preparation of Soil and if the plants receive ample water and protection from sun through at least the first year after moving.

It is essential that boxwoods be set at a proper depth. Plants that are set too deep or have settled so that the original soil line is raised 6 inches or more are almost invariably unthrifty, especially tree boxwoods. The original soil level should be preserved, or not raised more than 2 or 3 inches, after making allowance for the settling of the root ball. It is a mistake to set boxwoods so that the lower crotches are even with or below the ground level.

Box plants that are over 2 to 3 feet high or broad should be shaded for a year after they are transplanted, by a lattice that cuts off about half the light. Shading is highly important with large specimens of either dwarf or tree box, especially if the plants are moved from a partly shaded to a more exposed site. The shelter should clear the foliage by 10 to 18 inches and should protect at least the sunny sides as well as the top.

Transplanted boxwoods must be thoroughly and regularly watered. A slow flow of water that reaches underneath the crown to the trunk is necessary, and it should be continued until the root ball is wet through to the bottom. It is advisable to throw up a low ridge of soil encircling the root ball to prevent wastage of water from surface run-off and to allow more thorough wetting. After a plant has been thoroughly watered, a week can ordinarily elapse before another watering is necessary.

FERTILIZATION

The box is a heavy-feeding plant and, when liberally fertilized, is a vigorous and fairly rapid grower. Provided it has a well-established root system, a boxwood will remain alive and make a slow growth in

245296°—40——2

soil deficient in both plant food and water. The quantity of fertilizer to be given and the frequency of application will depend mostly on the size of the plant and the rapidity of growth one desires. Although excessive vegetative growth, which is lacking in cold resistance and may therefore suffer from winter injury, may be stimulated by heavy nitrogenous fertilization, such injury is more often the result of untimely rather than excessive feeding. In general, a well-fed plant is more likely to winter successfully than a starved one.

A general practice in estate plantings of boxwoods is to mulch the plants liberally with stable manure, preferably from cows, as soon as the ground freezes in the fall. The mulch is left until spring, when the coarser material is raked off and the fine material is left to mingle with the soil. The mulch should never be spaded or cultivated into the soil. The only objection to this method is that all the plant food is applied on the surface and is mostly absorbed by the superficial roots, whereas the deeper roots are starved. As it is the deeper and central part of the root system on which the apical parts of the plant depend, the starving of these roots leads to correspondingly weak growth in the middle or top. Dwarf boxwoods are often seen in which the central parts are weak although the peripheral parts are vigorous. In the tree box where the lower branches often layer themselves the superior vigor of the peripheral parts is even more marked. This result is associated with watering and feeding practices that only reach the surface and the margin of the root system. The remedy is to apply commercial fertilizer ("tree food") in perforations within the area of crown spread as well as around the margin. The holes should be 1 to 1½ feet apart and about the same depth. Care must be taken in boring or punching the holes not to injure large roots.

Plants that have been weakened by neglect of feeding and watering can often be restored to vigor by excavating a trench 1½ to 2 feet wide and equally deep just outside the root ball, and filling it with a mixture of topsoil, stable manure, and leaf mold or peat. The trench can be widened and refilled with fresh material at intervals of several years. Radial trenches extending toward the center of the root zone may be prepared and filled in the same way provided care is exercised not to damage large roots.

Where stable manure is not available or its use is objectionable, various organic byproducts and residues, such as bonemeal, cottonseed meal, and tankage, may be used or commercial tree foods may be preferred. Large plants should be fed through perforations, but a surface application will suffice for small shrubs. These applications should be made in the late fall just before the ground freezes, or as soon as it thaws in the spring. No fertilizer should be applied to boxwoods after shoot growth is well advanced in the spring, nor in midsummer or early fall, as such applications may delay the maturity

of the shoots or even induce a second growth, which does not harden up before the advent of freezing weather and, therefore, is readily injured by temperatures only a few degrees below freezing.

WATERING

Boxwoods that are thoroughly watered at regular intervals make better growth and suffer less from disease, spider mites, and freezing than those whose water supply is at times deficient and again excessive. Frequent and light watering which wets only the surface of the soil is detrimental. The box plant is well adapted in root and leaf structure to endure moderately dry conditions, and it is a mistake to water boxwoods so persistently through the season that the foliage is always "soft." Most of the watering should be done before midsummer, and it is important not to permit a deficiency of rainfall to cause a growth check before this time. From midsummer on, water can be given more sparingly, allowing shoot growth to slacken and harden before freezing weather is expected. Box plants that suffer a growth check before midsummer because of deficiency of water often start into second growth with the advent of fall rains and suffer from winter injury because of their immaturity. A pronounced bronze leaf color during the winter is symptomatic of this type of injury, but the normal green color usually returns in the spring. Complete blanching of the foliage is indicative of death by freezing, but except in newly transplanted or devitalized plants severe freezing injury is usually restricted to "second growth."

On the other hand, boxwoods must not be allowed to enter winter dormancy with a dry soil. If rainfall is deficient during the fall, the plants should be heavily watered just before settled freezing weather is expected. In the event of delayed cold weather or if rain or snowfall is deficient during the winter, several post-season waterings may be needed.

WINTER PROTECTION

A mulch of stable manure during the winter serves the multiple purpose of fertilization and protecting the soil against rapid temperature changes, deep penetration of frost, and excessive water loss. A mulch of leaves, straw, or peat serves the protective purposes about as well but does not add plant food. In wind-swept and sunny sites some form of ground cover during the winter is almost indispensable. In the areas best adapted to box culture no other winter protection is needed, and where recurrent warm weather may be expected during the winter, a cover over the crown is actually detrimental. Where winter covers are necessary they should be constructed of only one thickness of burlap or ventilated around the bottom. It is imperative

to have sufficient clearance between the foliage and burlap so that contact and friction will not occur even when the burlap is weighted down with snow. The winter cover should not be put on until steady cold weather is at hand, usually not until the ground surface freezes, and it should be removed as soon as the risk of temperatures below the 20's is past. Mild frosts following removal of the covers do little or no harm, but delaying their removal may kill or weaken the shoots.

PRUNING

Only boxwoods that are grown as a hedge or are shaped to some other special form are ordinarily pruned. When grown with adequate light, they will form a dense surface of foliage without being sheared. In fact the surface growth may become so compact that very little light and air reach the center of the crown, and the interior shoots may die as a result. As the dead parts are commonly overgrown by fungi, such as *Macrophoma* on the leaves and *Volutella* on twigs and leaves, their death is mistakenly attributed to these organisms. Usually only the small branches are killed outright; the larger ones continue to put out laterals. If the surface shoots are thinned so as to admit light to the interior, these laterals will grow and form a green center, and the result will be a handsomer and healthier plant than one that has only a shell of green shoots and is bare or congested with dead branches and foliage within.

Because the wood is hard and brittle and the branches are given off at a narrow angle, it is difficult to use shears in thinning boxwoods, and their use leaves branch stubs that may afford an entrance point to fungus parasites. A neater and easier method is merely to break off surplus shoots, at least those of a quarter inch or less in diameter, at their junction with larger branches. This can be done most readily in the early spring or late summer as the wood is then most brittle. Where larger branches must be removed, the usual precautions to make a close, clean cut without bruising or tearing the bark should be observed, and cuts having a surface of a square inch or more should be promptly coated with shellac followed by tree paint. The interior parts of a boxwood should be cleaned annually of accumulated debris, such as leaves, twigs, birds' nests, etc. A thorough shaking and the removal of the more adherent material by hand ordinarily accomplish this purpose. Without such cleaning, fungus growth on leaves and twigs is promoted, the development of interior shoots is suppressed, and sometimes aerial root development along the branches is induced. Although boxwood hedges are a favorite gathering place for spiders, their webs are only unsightly and in no way injurious to the plant.

DISEASES

LOW VITALITY AND GENERAL DECLINE

Complaints that boxwoods are sickly or dying have been frequent since the drought years in the eastern United States, 1930 and 1931, and the years of exceptionally cold winters, 1934 and 1935. The symptoms usually include one or more of the following phases: (1) Loss of color, the foliage becoming yellowish or grayish green; (2) weak shoot growth and premature dropping of old leaves; (3) death of entire branches, especially in the middle and apical parts of the crown; (4) the occurrence of sunken areas in the bark of the trunk just above the ground line or in the crotches and along the sides of main branches. Examination of the sunken bark may show that it is brown throughout or contains brown streaks and that in many places it has separated from the wood so that patches of considerable size can be stripped off. During periods of moist weather fungus fruiting bodies in the form of small (one-sixteenth- to one-eighth inch) pinkish pustules appear on the surface of the injured bark or erupt through cracks that develop in it.

The first two symptoms may be associated with defective soil drainage, with a hard, infertile soil, too deep covering of the root, or with failure to become well rooted after transplanting. The third and fourth symptoms almost always betoken winter injury to the cambium, or growing tissue, of the stem, by which the wood and bark are formed. Winter injury of this type usually indicates that the plant experienced a growth check during the summer and was stimulated into untimely growth by rainy periods in the fall and that this second growth did not harden off before freezing weather occurred. In mild or "open" winters, plants that were properly dormant in the fall may be coaxed into cambium activity on warm days, especially if they are exposed to direct sunlight. The recurrence of freezing weather injures or kills the new tissue thus formed, and sometimes causes the bark to freeze and separate from the wood.

As the primary causes of these pathological symptoms are cultural or climatic, the first step in remedying them is to make the cultural conditions conform as far as practicable to the specifications previously given. Strictly climatic factors are less or not at all amenable to control, but where the cultural methods are favorable the effects of adverse weather are much less marked.

TWIG BLIGHT AND LEAF CAST

The premature shedding of leaves, resulting sometimes in complete denudation and ultimate death of twigs (fig. 6), may also have its origin in the same conditions that cause low vitality and general

FIGURE 6.—So-called twig blight of box. This is a form of winter injury to twigs that grew too late to mature before, or were too poorly nourished to survive during the winter. Fruiting bodies of the box leaf-cast fungus, *Macrophoma candollei*, are shown on the leaves, especially at *a*, and those of the twig-blight fungus, *Volutella buxi*, at *b*. Both fungi develop only on weak or injured plant parts.

decline. These effects are usually indicative of accessory pathological factors, one of the most important of which is the foliage injury caused by red spider mites and, especially in tree boxwoods, by leaf miners. Aside from providing favorable cultural conditions, the control of these insect pests is prerequisite for the maintenance of healthy boxwoods.

As foliage injury by red spider mites and injury by drought are often associated, regular and thorough watering is one of the principal requirements in remedying or preventing defoliation. Adequate fertilization is another. Where water under sufficient pressure is available, repeated forceful spraying of boxwood foliage with water from a garden hose is a fairly effective deterrent of spider mites and is not objectionable from the standpoint of inducing fungus diseases of the foliage provided it is done in bright dry weather and the plants are free from debris and well ventilated.

Fungicidal spraying is not ordinarily required to overcome twig blight and leaf cast, but boxwoods stand any of the ordinary fungicidal sprays, such as homemade and commercial forms of bordeaux mixture and lime sulfur. The dilutions recommended for summer spraying of evergreens or of deciduous shrubs should be followed. For bordeaux mixture this is ordinarily the 4–4–50 formula (4 pounds of bluestone, 4 pounds of hydrated lime, 50 gallons of water); with lime sulfur-dilution of the liquid concentrate at 1 to 40 or 1 to 50, or of the powdered form 1 pound to 10 or 12½ gallons of water is required. The best time to spray boxwoods is in the spring before the growth of new foliage is complete, as the new leaves soon cover and conceal the sprayed foliage on which bordeaux mixture especially makes an unsightly coating. Where fungus infection of the foliage persists through the summer a fall application in addition may be desirable, especially to boxwoods that are to be covered with burlap during the winter.

WILT AND CANKER

Wilt and canker are aspects of the same disease, the term "wilt" being commonly applied to the rather sudden turning of color (to a light straw) and death of a single branch or the entire top of a small plant, whereas the term "canker" is applied to the slow death of one or more branches, or the trunk, of a large shrub or tree. Fungi known as *Volutella buxi* (Cda.) Berk., and *Verticillium buxi* (Schm. ex Fr.) Awd. and Fleisch., which may be merely phases of the same life cycle, are characteristically associated with wilt and canker in boxwoods, but their significance as primary parasites is not fully established. The predominant factor in the establishment of these fungi in boxwoods is freezing injury either to unhardened shoots or

to unseasonably active cambium. The shoot injury is usually completed by freezing alone, and the fungi grow only as saprophytes, whereas in the canker type of injury there may be a secondary extension of the fungi into previously uninjured bark and wood (fig. 7).

FIGURE 7.—Trunk canker on a box tree. This is not quite typical, as ordinarily the wood remains covered by dead bark. Cankers may result from mechanical injuries and especially from the freezing of the cambium when the plants are not fully dormant during the winter.

The remedy for these diseases is surgery; that is, the pruning out of affected branches down to the lowest point that manifestations of disease can be traced, and the complete excision of bark cankers. This will usually require a worker skilled in the use of a pruning knife and gouge, as the discolored bark must be entirely removed, leaving a clean, firm juncture with healthy wood. Cutting out all streaks in the wood is probably advisable but not always practicable, as the streaks sometimes penetrate deeply and the branch structure would be weakened too much by their total elimination.

Wherever an area of wood over 1 square inch is exposed, it should be coated immediately with shellac, and large cuts and furrows should be covered with tree paint before the shellac coating is lost.

INSECTS AND RELATED PESTS

THE BOXWOOD LEAF MINER

The boxwood leaf miner (*Monarthropalpus buxi* Lab.) is a serious insect pest of the tree boxes, but apparently is of little importance on the dwarf, or English, variety of box. Evidence of its work is the occurrence, by late summer, of small oval blotches or blisters about one-fourth inch in diameter on the under surface of the leaves (fig. 8).

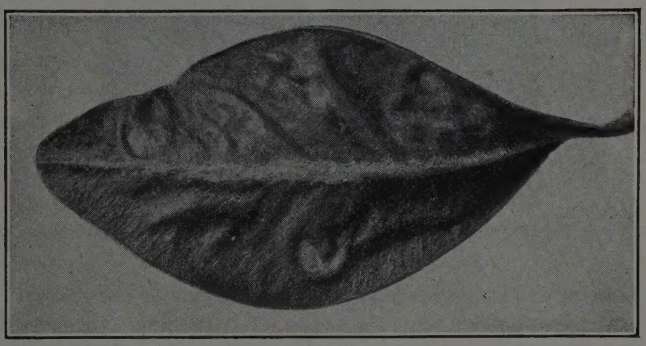


FIGURE 8.—Blisters produced by the boxwood leaf miner on the under surface of a boxwood leaf. Four times natural size.

The injury is caused by the yellowish maggots of a very small gnat-like fly, which mine inside the leaves and hollow out these areas. Heavy infestations cause serious injury to many of the leaves, premature shedding, and a gradual weakening of the plants. The delicate, orange-colored flies (fig. 9), about one-tenth inch long, emerge from the mines in the leaves during a period of about 2 weeks in the spring after the new leaves are fairly well developed. They lay their eggs in the new leaf tissue, and these hatch into a new generation of maggots, which mine the leaves until the following spring. This

period of flight is very important when control by spraying is being considered. At Washington, D. C., emergence begins anywhere from the last few days in April to the middle of May, depending on whether the season is early or late. Emergence would begin earlier farther south and later in localities farther north.

The most common method of control is to spray the infested and adjacent box plants during the flight period with a mixture of 1 gallon of cheap molasses, about 5 gallons of water, and 9 teaspoonfuls of nicotine sulfate. Start spraying as soon as the first flies are seen hovering about the plants, or the first tiny, whitish, empty pupal skins, from which the flies have emerged, are observed protruding from the mines on the under sides of the leaves. Repeat the spraying every 3 or 4 days or as often as is necessary to keep the foliage

FIGURE 9.—The adult, or fly, of the boxwood leaf miner. Twelve times natural size.

continuously sticky, especially the lower surface of the leaves. Continue the spraying for about 2 weeks, or throughout the period that the flies are active. If consistently applied, this sticky spray will trap and kill the insects and prevent their laying eggs in the new leaf tissue. Spraying at other times of the year will not kill the leaf miners. Fumigating with hydrocyanic acid gas or immersing plants in hot water are other methods of control, but these measures are more complicated and are practical only under certain conditions.[1]

THE BOXWOOD PSYLLID

The boxwood psyllid (*Psylla buxi* L.) is a small sucking insect related to the aphids or plant lice. It causes a characteristic cupping or curling of the new box leaves upon which it feeds. Twig

[1] For further information on these special control methods see U. S. Department of Agriculture Circular No. 305, The Boxwood Leaf Miner and Its Control.

growth may be retarded as a result of heavy infestation, but usually the injury is not serious. The adult psyllid is about one-eighth inch long and grayish green, whereas the wingless nymphs, or young, are covered with a white waxy excretion. The insects usually appear on the plants in the spring soon after the new leaves start out. They may be controlled at that time with a nicotine spray, about 1½ teaspoonfuls of nicotine sulfate and 1 ounce of soap being used in each gallon of water. A pyrethrum spray should give equally good results. Apply the spray as soon as the first psyllids are noticed and before many of the leaves have curled. If the infestation is severe, another application may be necessary a week or 10 days later.

SPIDER MITES

Spider mites, especially the common red spider (*Tetranychus bimaculatus* Harvey), frequently infest box. They are most likely to become a serious pest during prolonged dry periods. Spider mites feed by sucking the juices from the leaves. When numerous, they cause a light fading or gradual yellowing of the foliage and weaken the plants. Injured leaves will show a pale mottling or stippling on the upper surface. In some cases a fine webbing will be apparent on the surface of the leaves. The mites, however, are so small that they can scarcely be seen with the naked eye. If an infested branch is shaken over a white paper the mites may be seen as small, active specks. They are reddish or yellowish, are somewhat oval, and have four pairs of legs.

There are several insecticides that may be used to control infestations, if applied while the spider mites are present. Dusting several times with a dusting sulfur or spraying with a wettable sulfur is an effective method. Spraying repeatedly with derris or nicotine will usually give good results. A very efficient spray, recently developed by the Bureau of Entomology and Plant Quarantine, consists of 0.6 ounce or 4½ level tablespoonfuls of derris powder containing 4 percent of rotenone, 1 ounce or 2 tablespoonfuls of sulfonated castor oil (commonly known as turkey red oil), and 3 gallons of water. For larger quantities use 10 ounces of derris powder, 1 pint of sulfonated castor oil, and 50 gallons of water. If the derris powder purchased contains only 3 percent of rotenone, add one-fourth more derris than indicated above but use the same amount of sulfonated castor oil. First add the sulfonated castor oil to the water, then make a uniform paste of the derris powder by using a small amount of this solution and stir it into the rest of the solution. Two or more applications of any of these insecticidal materials at weekly or 10-day intervals are usually necessary for satisfactory control. Infestations can often be held in check by repeated washing of the foliage with a strong stream of water. This washing, as previously mentioned, should be done preferably in bright, dry weather.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

Secretary of Agriculture	CLAUDE R. WICKARD.
Under Secretary	PAUL H. APPLEBY.
Assistant Secretary	GROVER B. HILL.
Director of Information	M. S. EISENHOWER.
Director of Extension Work	M. L. WILSON.
Director of Finance	W. A. JUMP.
Director of Personnel	ROY F. HENDRICKSON.
Director of Research	JAMES T. JARDINE.
Director of Marketing	MILO R. PERKINS.
Solicitor	MASTIN G. WHITE.
Land Use Coordinator	M. S. EISENHOWER.
Office of Plant and Operations	ARTHUR B. THATCHER, *Chief.*
Office of C. C. C. Activities	FRED W. MORRELL, *Chief.*
Office of Experiment Stations	JAMES T. JARDINE, *Chief.*
Office of Foreign Agricultural Relations	LESLIE A. WHEELER, *Director.*
Agricultural Adjustment Administration	R. M. EVANS, *Administrator.*
Bureau of Agricultural Chemistry and Engineering.	HENRY G. KNIGHT, *Chief.*
Bureau of Agricultural Economics	H. R. TOLLEY, *Chief.*
Agricultural Marketing Service	C. W. KITCHEN, *Chief.*
Bureau of Animal Industry	JOHN R. MOHLER, *Chief.*
Commodity Credit Corporation	CARL B. ROBBINS, *President.*
Commodity Exchange Administration	JOSEPH M. MEHL, *Chief.*
Bureau of Dairy Industry	O. E. REED, *Chief.*
Bureau of Entomology and Plant Quarantine	LEE A. STRONG, *Chief.*
Farm Credit Administration	A. G. BLACK, *Governor.*
Farm Security Administration	C. B. BALDWIN, *Administrator.*
Federal Crop Insurance Corporation	LEROY K. SMITH, *Manager.*
Forest Service	EARLE H. CLAPP, *Acting Chief.*
Bureau of Home Economics	LOUISE STANLEY, *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*
Bureau of Plant Industry	E. C. AUCHTER, *Chief.*
Rural Electrification Administration	HARRY SLATTERY, *Administrator.*
Soil Conservation Service	H. H. BENNETT, *Chief.*
Surplus Marketing Administration	MILO R. PERKINS, *Administrator.*

U. S. GOVERNMENT PRINTING OFFICE: 1940

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - Price 5 cents